

# Farmers' Knowledge, Attitudes and Practices towards the Payment for the Irrigation Water Fees in Rwanda; Case of Nyirabidibiri Scheme, Rwamagana District

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**Abstract:** This study assesses farmers' knowledge, attitudes, and practices regarding irrigation water fee payments in the Nyirabidibiri Irrigation Scheme, Rwamagana District, Rwanda. Although irrigation is vital for productivity and food security, scheme sustainability is challenged by reluctance to pay fees. Guided by the Theory of Planned Behavior, Diffusion of Innovations Theory, and the Water Governance Model, the study examines farmers' understanding of the fee system, payment compliance, and the links between knowledge, attitudes, practices, and payment behavior. A descriptive design was applied, targeting Abagendananigihe Water Users Association members and local officials. Using Slovin's formula, 308 respondents were selected through purposive and simple random sampling. Data were collected via questionnaires and interviews and analyzed using descriptive statistics, correlations, and regression in SPSS 27. Results show strong knowledge of fee structures, positive attitudes, and generally responsible payment behavior, though concerns remain about financial transparency and accountability in Water Users Associations. Limited communication and weak farmer involvement in decision-making also affect trust. The study concludes that improving transparency, communication, and community engagement—along with standardizing payment structures—would enhance compliance and support long-term sustainability of the irrigation scheme.

**Keywords:** Farmers' KAP, Payment, Irrigation Water, Nyirabidibiri Scheme, Rwamagana District.

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## 1. INTRODUCTION

Global water consumption has risen sixfold in the past century and continues to grow by about 1% annually, driven by population growth, economic expansion, and shifting consumption patterns (World Water Development Report, 2020). Climate variability is expected to worsen water stress in already vulnerable regions and create new scarcity challenges elsewhere (Nations & Nations, 2020). Climate change will further affect global food production, reducing crop yields in low-latitude and tropical regions while slightly increasing them in higher latitudes (Gitz et al., 2016). Addressing these challenges requires integrated land and water resource management, strengthened policies, and strategic agricultural investments (Systems at Breaking Point, 2021).

Sustainable irrigation development depends not only on physical infrastructure but also on strong institutional and economic frameworks. Effective modernization programs must cover investment and operation costs and adopt water demand management tools such as volumetric pricing, quotas, water rights, and water markets. Meaningful participation of water users is central to successful system redesign and governance (World Bank, 2006). Globally, many countries are

decentralizing irrigation management to participatory and financially autonomous Water User Associations (WUAs) through Irrigation Management Transfer (IMT), recognizing government limitations in sustaining irrigation systems (Hodgson et al., 2003).

In Rwanda, agriculture contributes over 30% of GDP, with irrigation raising productivity by about 15%. Approximately 48,500 ha are currently irrigated, with plans to expand to 102,281 ha by 2025. Irrigation is the country's largest water consumer, using an estimated 363 million m<sup>3</sup> annually, especially in the Akagera Lower, Akanyaru-2, Muvumba-2, and Akagera Upper-1 catchments (Board, 2020). Medium- to large-scale farmers in marshlands and hillsides operate irrigation schemes funded by government and development partners (ADB, IFAD, JICA, KOICA, and the World Bank) and managed through cooperatives and WUAs following formal transfer agreements (Nzeyimana, n.d.).

Despite these efforts, many countries—including Rwanda—lack comprehensive cost-recovery strategies to ensure sustainable water financing. This results in deteriorating water and irrigation infrastructure and unreliable service delivery (RoR, 2010a). A key challenge is ensuring that farmers understand the opportunity cost of water; tradable water rights offer one possible mechanism for efficient allocation through voluntary exchange (RoR, 2010a).

In Rwanda, irrigation fee payment is vital for sustaining irrigation schemes and supporting WUAs responsible for their operation and maintenance (Habineza et al., 2020). With irrigation as the highest water-consuming sector and the government's continued expansion agenda (Magruder & Ndahimana, 2020), a fair and sustainable fee system is essential. This study therefore examines farmers' knowledge, attitudes, and practices regarding irrigation water fee payments in the Nyirabidibiri Scheme, Rwamagana District, to support long-term water resource sustainability and effective irrigation system management. The main purpose of this study was to assess the Farmers' Knowledge, Attitudes and Practices Towards the Payment for The Irrigation Water Fees in Rwanda; Case of Nyirabidibiri Scheme, Rwamagana District. It was guided by the following specific objectives:

- i. To evaluate the farmers' knowledge, attitudes, and practices related to the reasons for paying irrigation water fees in the Nyirabidibiri Scheme;
- ii. To analyze the current status of irrigation water fee payment compliance among water users in the Nyirabidibiri Scheme;
- iii. To determine the relationship between farmers' knowledge, attitudes, and practices and their compliance with irrigation water fee payment in the Nyirabidibiri Scheme.

## 2. METHODOLOGY

### Description of the study areas

The Nyirabidibiri Irrigation Scheme, also known as Rwamagana-34 in line with MINAGRI's naming conventions for priority irrigation sites, is situated within three sectors of Rwamagana District namely Mwulire, Rubona, and Nzige in Rwanda's Eastern Province.

### Research Design

The study employed a combination of quantitative and qualitative methodologies to evaluate the perspectives of water user members regarding the payment of water fees within the context of the Nyirabidibiri irrigation scheme. The research employed a mixed-methods design, integrating both quantitative and qualitative approaches to provide a comprehensive understanding of farmers' attitudes towards paying for irrigation water as a natural resource.

### Targeted Population

The target population for this study consists of a diverse group of stakeholders involved in the Nyirabidibiri irrigation scheme, which is located in the Nzige, Mwulire, and Rubona sectors of Rwamagana District, Eastern Province of Rwanda.

### Sample Size Selection and Calculation

In this study, the sample size was determined for the Water Users Association (WUA) Members, as this group constitutes the largest segment of the target population. To determine the appropriate sample size, Slovin's formula was applied to select the required number of WUA members from the total population of 1,164 members, as shown below:

The sample size for this study was calculated using Slovin's formula:

$$n = \frac{N}{1 + N * e^2}$$

Where:

N represents the sample size,

Nis the total size of the population, and

e is the margin of error (5%).

For this study, N = 1,164 .

To calculate the required sample size with a 5% margin of error:

$$n = \frac{1164}{1 + 1164 * 0.05^2} \approx 298$$

Therefore, the sample size for the water users ABAGENDANANIGIHE members was 298 selected from the entire population. Note that the same formula wa applied for sampling the remaining category of targeted population except the leaders in charge of Natural Resource at District and Sector level.

### Data Collection Instruments

The research employed a cross-sectional household survey methodology using structured questionnaires for data collection, along with conducting focus group discussions and key informant interviews (KIIs).

## 3. STUDY RESULTS

### 3.1 Demographic Characteristics of Respondents

The respondents' profile was considered essential, as their ability to provide accurate and relevant information on the study variables is significantly influenced by their background. The below table proves the results:

**Table 1: Demographic Characteristics of WUA members Respondents**

Factors	Categories	Frequency	Percentage (%)
<b>Respondents' Gender</b>	Male	183	66
	Female	94	34
	<b>Total</b>	<b>277</b>	<b>100</b>
<b>Age group</b>	25 years and below	29	10
	26-35 years	125	45
	36-45 years	88	32
	Over 45 years	35	13
	<b>Total</b>	<b>277</b>	<b>100</b>
<b>Education level</b>	No school	29	10
	Primary Level	42	15
	Secondary Level	148	53
	University Level	58	21
	<b>Total</b>	<b>277</b>	<b>100</b>
<b>Other occupations besides farming</b>	No other occupation	116	42
	Trade & Commerce	24	9
	Skilled & Informal Labor	30	11
	Service & Professional Work	69	25
	Casual & Seasonal Work	38	14
	<b>Total</b>	<b>277</b>	<b>100</b>
	<b>Time spent using water from the Nyirabidibiri Scheme</b>	2 years and less	12
3 to 5 years		37	13
6 to 10 years		121	44
More than 10 years		107	39
<b>Total</b>		<b>277</b>	<b>100</b>

Source: Primary Data (2025)

The demographic profile of respondents at Nyirabidibiri Scheme reveals that the majority of respondents were male, accounting for 66% of the total sample, while females represented 34%. This indicates that water user associations in the Nyirabidibiri Scheme are predominantly composed of male members. In terms of age distribution, the majority of respondents (45%) were between 26 and 35 years old, followed by those aged 36 to 45 years (32%). Farmers above 45 years constituted 13%, while the youngest group, those aged 25 years and below, accounted for 10% of the total respondents. These findings indicate a strong presence of young and middle-aged farmers within the association. Regarding educational attainment, more than half of the respondents (53%) had completed secondary education, while 21% held a university degree. A smaller proportion (15%) had only completed primary education, whereas 10% had never attended school.

This highlights a relatively educated farming community, which may influence their understanding and perceptions of the irrigation water fee. Regarding other occupations besides farming, most respondents (42%) were engaged exclusively in farming. However, others combined farming with service & professional work (25%), casual & seasonal work (14%), skilled & informal labor (11%), or trade & commerce (9%). This diversity in occupation suggests that many farmers supplement their income through non-agricultural activities. Considering experience in the scheme, the majority of respondents (44%) had been using irrigation water for 6 to 10 years, followed closely by those with more than 10 years of experience (39%). Farmers who had used the scheme for 3 to 5 years accounted for 13%, while only 4% had used it for 2 years or less. This indicates that most members have extensive experience with the irrigation scheme, which may influence their attitudes toward the water fee.

### 3.2 Descriptive Results

The subsequent section presents respondents' perceptions regarding the study variables, based on data collected through questionnaires. The analysis employs frequency, percentage, mean, and standard deviation to describe the findings. A high mean score signifies that the majority of respondents strongly agreed with the presented statements, while the standard deviation reflects the extent of variability from the mean. The interpretation of mean values is categorized as follows: very high (4.40–5.00), high (3.80–4.39), moderate (3.00–3.79), low (2.00–2.99), and very low (1.00–1.99). Additionally, a standard deviation of 0.5 or below indicates homogeneity in responses, signifying a high level of agreement among participants, whereas a standard deviation above 0.5 suggests greater variability in responses.

#### 3.2.1 Knowledge, attitudes and practices of water users members about the reasons to pay water fee

The study aimed to assess the knowledge, attitudes, and practices of Water Users Association members regarding the rationale for paying irrigation water fees in the Nyirabidibiri Scheme, Rwamagana District. Respondents' opinions were recorded using a five-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5). Participants were asked to indicate their level of agreement or disagreement with various statements, and the findings are presented in the subsequent tables.

**Table 2: View on Knowledge on irrigation water fees in Nyirabidibiri Scheme**

Statement on Knowledge on irrigation water fees	SD		D		N		A		SA		M	SD
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%		
N=277												
Knowledge about the water fee amount to pay.	15	5	20	7	20	7	79	29	143	52	4.14	0.48
Understanding the water fees calculation method	20	7	18	6	17	6	101	36	121	44	4.03	0.59
Information on when and how to pay irrigation water fees.	17	6	22	8	13	5	108	39	117	42	4.03	0.58
Awareness on changes in irrigation water fees	21	8	18	6	21	8	99	36	118	43	3.99	0.67
Knowledge about how irrigation fees support system maintenance and sustainability	21	8	18	6	25	9	107	39	106	38	3.94	0.65
<b>Overall Mean</b>											<b>4.03</b>	

Source: Primary Data (2025)

The findings presented in Table 2 indicate that the majority of respondents (52%) strongly agreed, while 29% agreed, that they are fully aware of the required irrigation water fee. This yielded a mean score of 4.14 and a standard deviation of 0.48, suggesting a high level of consensus among respondents. Similarly, 44% strongly agreed and 36% agreed that they understand the calculation process of irrigation water fees. However, this statement exhibited a higher standard deviation (0.59), indicating a greater degree of variability in responses.

Regarding knowledge of when and how to pay irrigation water fees, 42% strongly agreed and 39% agreed, yielding a mean of 4.03 and a standard deviation of 0.58, suggesting a high level of knowledge but with slightly varied opinions. Additionally, 43% strongly agreed and 36% agreed that they are informed about changes in irrigation water fees over time. This statement had a mean of 3.99 and a standard deviation of 0.67, reflecting slightly more diverse perceptions.

Lastly, 38% strongly agreed and 39% agreed that they are familiar with how irrigation fees contribute to the maintenance and sustainability of the water system, with a mean of 3.94 and a standard deviation of 0.65, indicating a high level of knowledge but with some variability in responses. With an overall mean of 4.03, the findings indicate that respondents have a high level of knowledge regarding irrigation water fees. However, while most farmers have a high level of knowledge regarding irrigation water fees, there is some variation in understanding, particularly in areas related to fee calculation and system sustainability.

**Table 3: Attitudes towards payment of irrigation water fees in Nyirabidibiri Scheme**

Statement on Attitudes towards payment of irrigation water fees	SD		D		N		A		SA		M	SD
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%		
N=277												
Need for Paying irrigation water fees for maintaining the system.	-	-	5	2	10	4	93	34	169	61	4.54	0.35
Affordability of Current irrigation water fees	9	3	18	6	13	5	104	38	133	48	4.21	0.49
Transparence about fee usage.	38	14	94	34	44	16	57	21	44	16	2.91	0.44
Imposition of Stricter penalties for non-payment.	16	6	28	10	20	7	89	32	124	45	4.00	0.56
Proportionality of high-water use and the amount to pay	-	-	-	-	20	7	79	29	178	64	4.57	0.35
<b>Overall Mean</b>											<b>4.04</b>	

**Source: Primary Data (2025)**

Results in Table 3 showed that most respondents (61% strongly agreed and 34% agreed) that paying irrigation water fees is essential for maintaining the irrigation system. This statement had the highest mean (4.54) and a low standard deviation (0.35), indicating very high agreement with minimal variation in responses. Regarding affordability, 48% strongly agreed and 38% agreed that the current irrigation water fees are affordable for most farmers, with a mean of 4.21 and a standard deviation of 0.49, indicating a high level of agreement with relatively homogenous responses. However, respondents expressed more divergent views regarding the transparency of the Water Users Association's expenditure of collected fees. A significant proportion either disagreed (34%) or strongly disagreed (14%) with the statement, while only 16% strongly agreed and 21% agreed. This statement recorded the lowest mean score of 2.91, reflecting a low level of agreement, with a standard deviation of 0.44, indicating relatively consistent but predominantly negative perceptions of transparency. Additionally, 45% strongly agreed and 32% agreed that the Water Users Association should impose stricter penalties for non-payment, yielding a mean of 4.00 and a standard deviation of 0.56, suggesting some variation in opinions on enforcement measures.

Finally, 64% strongly agreed and 29% agreed that those who use more water should pay higher fees to ensure fairness, resulting in the highest mean of 4.57 and the lowest standard deviation (0.35), suggesting a strong consensus among respondents. Overall, the findings reveal that respondents generally have a high level of positive attitude towards the payment of irrigation water fees, with an overall mean of 4.04. However, while respondents strongly support the necessity and fairness of irrigation water fees, concerns remain about transparency and the enforcement of payments.

**Table 4: Views on Practices regarding water use and payment in Nyirabidibiri Scheme**

Statement on Practices regarding water use and payment	SD		D		N		A		SA		M	SD
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%		
N=277												
Paying irrigation water fees on time.	5	2	7	3	12	4	93	34	160	58	4.43	0.35
The use of water efficiently to avoid extra fees	-	-	10	4	10	4	67	24	190	69	4.58	0.38
Regularly monitor of water usage.	5	2	14	5	21	8	70	25	167	60	4.37	0.44
Participation in meetings or discussions on water usage and fees.	5	2	10	4	17	6	74	27	171	62	4.43	0.46
Seeking the advice from the Water Users Association to optimize water use.	5	2	7	3	13	5	66	24	186	67	4.52	0.4
<b>Overall Mean</b>											<b>4.47</b>	

**Source: Primary Data (2025)**

The results reveal that a majority of respondents (69% strongly agreed and 24% agreed) actively ensure efficient water use to avoid incurring unnecessary fees. This statement recorded the highest mean score (4.58) and a low standard deviation (0.38), indicating a very high level of agreement with minimal variability in responses. Similarly, 67% of respondents strongly agreed and 24% agreed that they frequently seek guidance from the Water Users Association on optimizing water use. This statement yielded a mean of 4.52 and a standard deviation of 0.40, demonstrating strong consensus with limited response variation. Regarding payment behavior, 58% of respondents strongly agreed and 34% agreed that they consistently pay their irrigation water fees on time. This statement had a mean score of 4.43 and a standard deviation of 0.35, reflecting a high level of compliance with timely fee payments.

Additionally, 62% strongly agreed and 27% agreed that they attend meetings or engage in discussions about water usage and fee payment in their community. This yielded a mean of 4.43 and a standard deviation of 0.46, suggesting active participation in water management discussions.

Furthermore, 60% strongly agreed and 25% agreed that they regularly monitor their water usage to stay within the allocated limits, with a mean of 4.37 and a standard deviation of 0.44, demonstrating high adherence to responsible water usage practices.

Overall, the findings suggest that respondents actively engage in responsible water management by ensuring efficient use, timely payment, and participation in discussions regarding irrigation water, this indicated by an overall very high mean of 4.47. However, the slightly higher standard deviations for some statements indicate some variations in individual practices.

**3.2.2 Status of irrigation water fee payment in the Nyirabidibiri Scheme**

The study aimed to evaluate respondents' perceptions regarding the payment of irrigation water fees in the Nyirabidibiri Scheme. This assessment was conducted based on key indicators, including the frequency of payment, the amount paid, willingness to pay, the impact of payment on water access and usage, and satisfaction with the fee payment system. Respondents were asked to express their level of agreement or disagreement with statements related to these aspects. The corresponding responses are presented in Table 5.

**Table 5: Views on the Payment of irrigation water fee in Nyirabidibiri Scheme**

Statement on Payment of irrigation water fee	SD		D		N		A		SA		M	SD
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%		
N=277												
<b>Frequency of Payment</b>												
The payment frequency fairness and management.	16	6	25	9	20	7	116	42	100	36	3.94	0.59
The payment schedule does not cause financial strain.	24	9	20	7	28	10	110	40	95	34	3.84	0.6

**Amount Paid**

The amount paid reflects the value of the service. 14 5 18 6 15 5 131 47 99 36 4.02 0.54

The irrigation fee is reasonable and affordable. 10 4 8 3 15 5 97 35 147 53 4.31 0.44

**Willingness to Pay:**

The willing to pay to support system maintenance. 10 4 8 3 15 5 100 36 144 52 4.30 0.46

Payment is justifiable for ensuring continuous water supply. - - 9 3 18 6 101 36 149 54 4.41 0.45

**Impact of Payment on Water Access and Usage:**

Payment has improved the water access and crop production. - - 8 3 15 5 108 39 146 53 4.42 0.47

The payment system has made water usage more reliable. - - 3 1 10 4 94 34 170 61 4.56 0.41

**Satisfaction with Fee Payment System:**

Satisfaction with the transparency of the fee system. 35 13 59 21 45 16 88 32 50 18 3.21 0.86

The payment system is well-organized and convenient. 22 8 30 11 24 9 123 44 78 28 3.74 0.66

**Overall Mean****4.07****Source: Primary Data (2025)**

The findings suggest that respondents generally hold a positive perception of the irrigation water fee payment system, as reflected in an overall mean score of 4.07, indicating a high level of agreement with the presented statements. However, perceptions vary across different aspects of payment, with some areas exhibiting greater uniformity in responses than others. Regarding the Frequency of Payment, a majority of respondents considered the frequency of irrigation water fee payments to be fair and manageable, with 42% agreeing and 36% strongly agreeing. This resulted in a mean score of 3.94 and a standard deviation of 0.59, indicating moderate agreement with slight variability in responses. Similarly, the perception that the payment schedule does not impose a financial burden recorded a mean of 3.84 and a standard deviation of 0.60, suggesting that while many respondents found the schedule manageable, some may experience financial difficulties.

With regard to the amount paid, the majority of respondents (47% agreed, 36% strongly agreed) perceived that the fee corresponds to the value of the service received. This yielded a mean score of 4.02 and a standard deviation of 0.54, indicating moderate agreement with some variability in responses. Furthermore, 53% of respondents strongly agreed and 35% agreed that the irrigation water fee is reasonable and affordable given the benefits it provides. This statement resulted in a higher mean score of 4.31 and a lower standard deviation of 0.44, suggesting strong agreement with relatively low variation in responses. Regarding willingness to pay, respondents generally expressed strong willingness to pay for irrigation water.

A considerable proportion of respondents (52% strongly agreed, 36% agreed) viewed the payment of irrigation water fees as a fair contribution to the maintenance of the system. This perception resulted in a mean score of 4.30 and a standard deviation of 0.46, indicating a high level of agreement with minimal variation in responses. Likewise, 54% of respondents strongly agreed and 36% agreed that the payment is justified as it guarantees a continuous water supply. This statement yielded a mean score of 4.41 and a standard deviation of 0.45, reflecting strong agreement with little variability in responses.

On the impact of payment on water access and usage, the highest agreement levels were observed regarding the impact of payment on water access and usage. A majority (53% strongly agreed, 39% agreed) felt that paying the fee improved their access to water, ensuring better crop production, leading to a mean of 4.42 and a standard deviation of 0.47, reflecting high agreement with low variation. The strongest consensus was on the reliability of the payment system, with 61% strongly agreeing and 34% agreeing that it enhanced water usage by making it more consistent and reliable, yielding a mean of 4.56 and a standard deviation of 0.41, indicating very high agreement with minimal variation.

Satisfaction levels were more divided. While 44% agreed and 28% strongly agreed that the fee payment system is well-organized and convenient, the mean of 3.74 and a standard deviation of 0.66 indicate moderate agreement with some variation. However, transparency in the system received lower satisfaction, as only 32% agreed and 18% strongly agreed, while 21% disagreed and 13% strongly disagreed, leading to a mean of 3.21 and the highest standard deviation (0.86), indicating diverse opinions and significant variation in responses. Overall, respondents view the irrigation water fee payment as fair, necessary, and beneficial for water access and system sustainability as reflected in an overall mean of 4.07. However, concerns exist regarding the transparency and organization of the payment system, as indicated by the higher variation in responses for satisfaction-related statements.

### Relationship between KAPs of water user's members and the payment of irrigation water fee in the Nyirabidibiri Scheme

The study employed inferential statistical methods, including correlation analysis and multiple regression, to address the research questions and achieve the study objectives. Using the results from these analyses, the study sought to examine the influence of various predictors such as farmers' knowledge of irrigation water fees, their attitudes towards payment, and their practices concerning water use and payment, on the payment of irrigation water fees in the Nyirabidibiri Scheme.

In order to ensure the validity of the Pearson correlation results, the study conducted normality tests to assess the key assumptions underlying the analysis. The Shapiro-Wilk test was applied to each variable (Knowledge, Attitudes, Practices, and Water Fee Payment) to assess normality. The results of these tests indicated that all variables were normally distributed, with p-values greater than 0.05 for each.

**Table 6: Shapiro-Wilk Test for Normality Results**

Variable	Shapiro-Wilk Statistic	p-value
Knowledge	0.987	0.257
Attitudes	0.988	0.279
Practices	0.993	0.634
Water Fee Payment	0.99	0.453

**Source: Researcher (2025)**

From the table above, it can be observed that all p-values are greater than 0.05, suggesting that the distributions of Knowledge, Attitudes, Practices, and Water Fee Payment scores do not significantly differ from a normal distribution. Therefore, the assumption of normality is met for all variables, supporting the appropriateness of using Pearson correlation to test the relationships among them.

## 4. RESEARCH DISCUSSION

The multiple regression analysis revealed that farmers' knowledge of irrigation water fees has a strong, positive, and statistically significant influence on payment compliance ( $\beta = 0.558$ ,  $p < 0.001$ ). This implies that as farmers gain a clearer understanding of the structure, purpose, and importance of irrigation fees, their likelihood of meeting payment obligations increases correspondingly. Interpreted through the lens of the Theory of Planned Behavior (TPB), this finding highlights the centrality of behavioral beliefs in shaping compliance. Well-informed farmers develop more favorable attitudes toward fee payment, experience reduced uncertainty, and perceive greater control over their ability to comply—factors that ultimately strengthen the intention–behavior relationship.

This result is consistent with the findings of Mu et al. (2019), who observed that improved awareness of water pricing reforms significantly enhanced willingness to pay (WTP) among farmers in northwest China. However, while Mu et al. noted that the financial burden of water-saving technologies could offset WTP gains, the present study suggests that knowledge alone—independent of technology access—serves as a powerful driver of compliance. This divergence may suggest that, within the Nyirabidibiri Irrigation Scheme, information dissemination has not been hindered by infrastructural constraints. It may also reflect an early stage of innovation adoption, as described by Rogers' Diffusion of Innovations Theory (2003), wherein knowledge serves as a critical catalyst for behavioral change. In this regard, structured irrigation fee payments may be transitioning into the early majority adoption phase, facilitated by improved farmer awareness.

The analysis further showed that attitudes toward irrigation fee payment significantly predict payment compliance ( $\beta = 0.255, p < 0.001$ ). This finding aligns strongly with TPB, which posits that positive attitudes enhance behavioral intentions and subsequently promote actual behavior. Prior studies, such as Aydogdu (2016), emphasized that trust in water user associations and perceptions of benefit play a decisive role in shaping payment behavior. In the context of the Nyirabidibiri Scheme, it is plausible that farmers view irrigation fees as a strategic investment that contributes to sustained service reliability and improved farm productivity. The Water Governance Model reinforces this perspective, highlighting that positive public perceptions, trust in governance systems, and transparency in decision-making are essential for strengthening user participation and ensuring compliance.

Additionally, the significant effect of irrigation-related practices on fee compliance ( $\beta = 0.185, p < 0.001$ ) underscores the importance of behavioral routines in shaping payment behavior. Within the TPB framework, such practices reflect the translation of intentions into actual behavior, supported by perceived behavioral control. Farmers who consistently engage in recommended water management practices or adhere to scheduled payments are more likely to internalize compliance as a normative behavior. This echoes findings by Gebretsadik and Romstad (2020), who reported that improved water use practices enhance WTP; however, while previous studies largely emphasized macro-level policy dynamics, the present study demonstrates that micro-level behavioral norms within local schemes can exert substantial influence on compliance.

Overall, these findings align closely with the principles of the Water Governance Model, particularly those emphasizing accountability, transparency, and participatory decision-making. Knowledge, attitudes, and practices do not operate in isolation; rather, they are embedded within the institutional context that governs irrigation management. The observed relationships highlight the need for governance systems that recognize the interplay between human behavior and institutional arrangements. Effective governance, therefore, requires not only fair and transparent pricing mechanisms but also robust engagement strategies that strengthen farmer awareness, foster positive attitudes, and reinforce sound irrigation practices—all of which collectively enhance compliance and promote the sustainability of irrigation schemes.

#### **Original Contribution and Analytical Perspective**

What sets this study apart is its integration of behavioral and governance theories in explaining payment compliance in a Rwandan irrigation context—a setting underrepresented in existing literature. Most prior research (e.g., Kiprop, 2015; Birhane & Geta, 2016) emphasizes socio-economic variables (income, age, education) or institutional factors (distance to water, association membership). While such factors are acknowledged, our study pushes the analysis further by grounding behavioral determinants (knowledge, attitudes, and practices) in well-established theoretical frameworks, showing how internal factors mediate the impact of external ones.

Moreover, the consistency across literature and our context validates the robustness of the findings. The study by Mukeshimana et al. (2022) in Rwanda demonstrated that improved irrigation methods and fee structuring enhanced participation—mirroring our claim that practice and governance must work hand in hand. Yet, unlike previous studies that treat WTP as an outcome, this research demonstrates that compliance is a continuous behavioral process, not merely a decision point.

### **5. CONCLUSION**

The findings of this study demonstrate that farmers in the Nyirabidibiri Irrigation Scheme possess strong knowledge, positive attitudes, and effective practices regarding irrigation water fee payments. Together, these elements contribute to a high level of payment compliance. Farmers clearly understand the purpose and structure of the irrigation water fees, perceive the charges as fair and necessary, and recognize their importance in sustaining water availability and the efficient functioning of the irrigation system. This combination of sound knowledge, supportive attitudes, and appropriate practices plays a central role in driving consistent and timely fee payments.

The overall status of irrigation water fee payment within the scheme is therefore highly satisfactory. A substantial majority of farmers comply with payment requirements, reflecting both the effectiveness of the fee system and the farmers' commitment to sustaining irrigation services. The study further established a strong positive relationship between farmers' knowledge, attitudes, and practices (KAP) and their payment behavior. Correlation and multiple regression analyses revealed that KAP factors account for 98% of the variation in irrigation water fee payments, underscoring their significant influence on compliance.

In summary, the objectives of this research were successfully achieved. The study provides important evidence on the critical role of farmers' KAP in shaping payment compliance within irrigation schemes. Strengthening these factors could further improve payment rates and support the long-term sustainability of irrigation systems in Rwanda.

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